DSHS
Mr. Ellis

The Nature of Matter Lab 1: Density of Water

Introduction

In this lab, students will explore an intensive physical property called density. From their findings, students should be able to describe how density changes based on the quantity of a sample. The concept of density can help explain why a cruise ship weighing hundreds of pounds can stay afloat on the ocean and yet a paperclip weighing only one gram will sink to the bottom.

Question / Aim: What is the density of what and how does the density of water change as the volume of water changes
Independent Variable: Volume of water
Dependent Variable: Mass of water
Controlled Variable(s): type of water, graduated cylinder

Hypothesis
The density of water will increase as the volume of water increases

The density of water will decrease as the volume of water increases

The density of water will remain constant as the volume of water increases.

Design

Supply List

Graduated cylinder, digital scale, distilled water

Procedure

1. Obtain a graduated cylinder and mass it on the triple beam balance or digital scale.
2. Fill the graduated cylinder with a random amount of water. Record the volume of water indicated by the graduated cylinder
3. Record the mass of the graduated cylinder with the measured volume of water.
4. Determine the mass of the water by taking the total mass of the graduated cylinder with the water and subtracting your original mass of the graduated cylinder.

Results

Overview

The data collected in the lab were quantitative values. Density is considered the amount of mass present in a given amount of volume. The mass of water was found by taking the mass of the graduated cylinder with water in it and subtracting the mass of an empty graduated cylinder.

Create an XY scatter graph. Be sure that you label your chart, label your axis, and include a trendline for your data.

Presentation

Volume (mL)	Total Mass (g)	Water Mass (g)
0		--

Evaluating Results

Conclusion

1. What type of relationship do you notice about the volume and mass of water?

2. How does the shape of the graph show this?

3. Find the numerical value of the slope of your trendline.

4. What are the units of your trendline?

5. The trendline represents a term called density. Looking at the trendline of your graph. Do you think the density of water will change for large amounts of water or small amounts of water? Why or why not?

The Nature of Matter Lab 2: Determining Density of Unknowns

Obtain one of the labeled density blocks. Determine

the mass to the nearest tenth of a gram on an electronic balance. Record the mass of the block in the appropriate space in Data Table I.

Measure the length, width and height of the block in centimeters. Be sure to estimate one past the known value. This means that each length should have two decimal places (ex: $2.1\underline{2}$ the underlined value is the estimated measure). Record these values in Data Table I.

Determine the volume of the block by using the following formula and record values in Data Table I:

$$V = L \times W \times H$$

Determine the density of the block and record values in Data Table I.

Table I

Substance	Mass (g)	L (cm)	W (cm)	H (cm)	Volume (cm	Density (g/cm
#1						
#2						
#3						
#4						
#5						
#6						
#7						
#8						

Compare the volume of each different type of block. What pattern do you notice?

Is this same pattern evident for the density you calculated for each different type of block? Why / why not?

Refer to the density of given samples in Data Table II. From this, determine the type of substance that each sample is and fill in Data Table III.

Table II

Material	Density (g/cm
Pine	0.35 - 0.50
Oak	0.60 - 0.90
Polypropylene	0.91 - 0.94
Acrylic	1.1 - 1.2
PVC	1.39 - 1.42
Aluminum	2.70
Steel	7.9
Brass	8.4 - 8.8
Copper	8.96

Table III

Substance	Material
#1	
#2	
#3	
#4	
#5	
#6	
#7	
#8	
#9	

Complete the table below based on the prediction if the nine materials you calculated density for.

Predicted	Actual
Sink:	Sink:
Float:	Float:

The Nature of Matter Lab 3: Penny Difference

Objective: To determine the density of a penny. Also to compare the density of pennies minted in different years.

Procedure:

1. Determine the range (youngest to oldest) of your sample of pennies. Record in the data table.
2. Find the mass of the pennies by placing them on the balance. Record the mass in the data table.
3. Place water in the graduated cylinder. Record the amount of water in the data table to the proper decimal place. (Remember to estimate one number past what is marked on the graduated cylinder)
4. Carefully add your pennies to the cylinder to avoid and splashing. Record the new volume level to the appropriate decimal place.
5. Pour the contents of your cylinder in the colander in the sink (based on your pennies date range).
6. Wipe up any spills and return to your seat.

Data Table:

Table I: Data of Pennies from Cup A			
Total Mass of pennies	Initial Volume	Final Volume	Total volume of Pennies
Pennies date **range** (youngest to oldest)			

Table I: Data of Pennies from Cup B			
Total Mass of pennies	Initial Volume	Final Volume	Total volume of Pennies
Pennies date **range** (youngest to oldest)			

Calculations:

1. Determine the total density of your sample of pennies be sure to include units!

Conclusion:

1. Why did the procedure tell you to determine the mass of the pennies before the volume? How would your results have been different if you had determined the volume first? <u>Explain using complete sentences.</u>

2. Compare the average densities of the pennies from cup A and cup B. Which had the higher density?

3. What is the date that separates pennies from cup A compared to cup B?

4. Research what happened to the makeup of pennies around this date that would cause a difference between the two groups of pennies. (Show percentages of material)

    a. Pennies minted from the late 1940's through _________ were composed of

    b. Pennies minted from _________ to present are composed

5. One of the metals listed above has a density of 8.96 g/mL and the other a density of 7.13 g/mL. Using the above information, determine which metal has which density. Explain your reasoning.

The Nature of Matter Lab 4: Temperature of Phase Changes

Introduction

Atoms of any matter are in constant motion. This concept is referred to as the Kinetic Theory of Matter. Kinetic energy is the energy that an object has as a result of moving. As the atoms gain energy their motion increases. The way we measure this motion is temperature. As the atoms move faster the temperature increases.

Question / Aim: How does the kinetic energy of a material change as it goes through a physical change?
Independent Variable: Time exposed to heat
Dependent Variable: Temperature of water
Controlled Variable(s): type of water, heating plate setting

Hypothesis
Kinetic energy of a material will change as it experiences a phase change.

Kinetic energy of a material will remain constant as it experiences a phase change.

Design

Supply List

250 mL beaker, glass stir rod, alcohol thermometer, ice, heating plate, stop watch

Procedure

1. Place approximately 200 ml of ice into a beaker.
2. Place the beaker on the hotplate and turn the hotplate on high. You need to continuously stir the ice/water mixture to ensure even heating.
3. Take temperature readings every minute and record the data in the table below. Be sure to estimate on your measurement. It is unlikely that ever measurement will be exactly .0 or .5!
4. **Do NOT** let the thermometer touch the bottom of the beaker; this will give you the temperature of the hotplate and not the contents of the beaker.
5. Make a note in your data table of the time when the last of the ice is melted; and, when the water begins to boil (bubbles reaching the top).
6. Continue to take readings at least 3 minutes **AFTER** the water begins to boil.

Results

Overview

Create an line graph. Be sure that you label your chart and your axis.

Presentation

Time (min)	Temperature (C)	Time (min)	Temperature (C)
0.0		18.0	
1.0		19.0	
2.0		20.0	
3.0		21.0	
4.0		22.0	
5.0		23.0	
6.0		24.0	
7.0		25.0	
8.0		26.0	
9.0		27.0	
10.0		28.0	
11.0		29.0	
12.0		30.0	
13.0		31.0	
14.0		32.0	
15.0		33.0	
16.0		34.0	
17.0		35.0	

Evaluating Results

Conclusion

1. On your graph, label where the water was in solid, liquid, and gas form.
2. ***According to your data***, what is the melting point? ______________
3. ***According to your data***, what is the boiling point? ______________
4. Is thermal energy being gained or lost as the temperature increases? ________________
5. What's happening to the kinetic energy on the sloped parts of the graph?
6. What's happening to the kinetic energy on the horizontal parts of the graph?